# ACE MEETING, May 25, 2004

- Tevatron Schedule
  - "Stack and Store" week with tornados and thunderstorms in parallel.
  - Various machine studies or "end of store studies" but disruptions will hopefully be small.
  - Store 3530 had third highest CDF initial luminosity. COT should be kept at full voltage for at least a few more stores. This is a great week to integrate lots of data and perhaps set some records!

    | **Store** | **Luminosity** ($sec^{-1}cm^{-2}$) |
    |---|---|
    | 3261 | 71.6E30 |
    | 3275 | 69.4E30 |
    | 3530 | 68.4E30 |
    | 3532 | 72.1E30 New record this morning! (5/25/04) |

- Ace Action Items
  - Tornado season goes on! Monitoring Ace may use the blue "End of Store"button if we are taking data and have a tornado/severe weather alarm. (Or just head for shelter.)

    Do *not* use this button during middle of store since it turns off CLC (rare during store). SciCo has a new "all clear" pager that is suppose to actually work.
  - We had a **Fire Alarm** this week. Please review the other emergency response procedures. Some SciCOs will appreciate advice and consultation. Remember it is hard to write a emergency flow chart that exactly covers all situations. Be careful to not over-react **OR** under-react.
  - Please continue to PAUSE runs when we have a trigger inhibit and do not resume until you are sure problem has been cleared.
  - Keep track of PSM alarms to keep pressure on to solve this problem.

- Training (2 weeks of overlap and classes)
  - Overlap starts Friday May 28 OWL! (i.e. just after midnight on

Thursday)
  - Normally Ace Classes would be June 2-3 (Wed,Thur) but these days are also Annual Fermilab Users Meeting. We are not yet sure if this will require rearranging class schedule.
  - Last overlap shift is EVE Thursday, June 10.

- NEW TOOLS
  - Paul's new detector guide
  - ACNET page D44 rearranged by Paul

    (please be careful when changing ACNET or web tools - they may be used
    by non-ACEs)
  - What can **YOU** help clean up **before** the new ACEs start Friday?

- List of pages/tools etc that need help
  - Do you think we could do a "ACE daq_guide" similar to Paul's detector guide above?
  - Calibration pages (out of date, many start with telling you how to load Run Control etc and needed details are buried ) - JJ has comments from a couple of people. Care to add yours?
  - March Classes
    - Did it work to move some classes to the Tuesday Ace Meeting slots?
      If so, did we move the correct classes? What others could go to Ace Meeting?
    - Did any classes overlap such that we should combine talks?
    - Does the order matter?
    - Any classes we should just plain drop?
  - What Every Ace Should Know

    Would anyone be interested in reviewing this AND turning it into a **checklist that we you can use during overlap?** In particular, I would like the list re-ordered into logical progression of training.
  - **What is the one topic that you struggled with the most as an ACE?**

- whether or not we had a class or lecture on subject?

```
Date: Sun, 23 May 2004
From: PJLujan
To: cdf_aces@fnal.gov
Cc: jj@fnal.gov
Subject: ACNET plots

Hello all,

In the interest of making the hourly ACNET plots less tedious,
I've rearranged all of the saved plots in the D44 Lumberjack
Plotter screen. The four hourly plots (shift losses, SI-Test1,
SI-Test2, and abort gap) are now the first four in the save list,
and the other two plots commonly used (integrated SVRAD and shift
luminosity) are directly below those.
```

I've tried to organize things so that the first column contains the plots directly relating to CDF, the second column contains plots relating to other parts of the Tevatron, the third column contains people's personal plots, and the fourth column is miscellaneous.

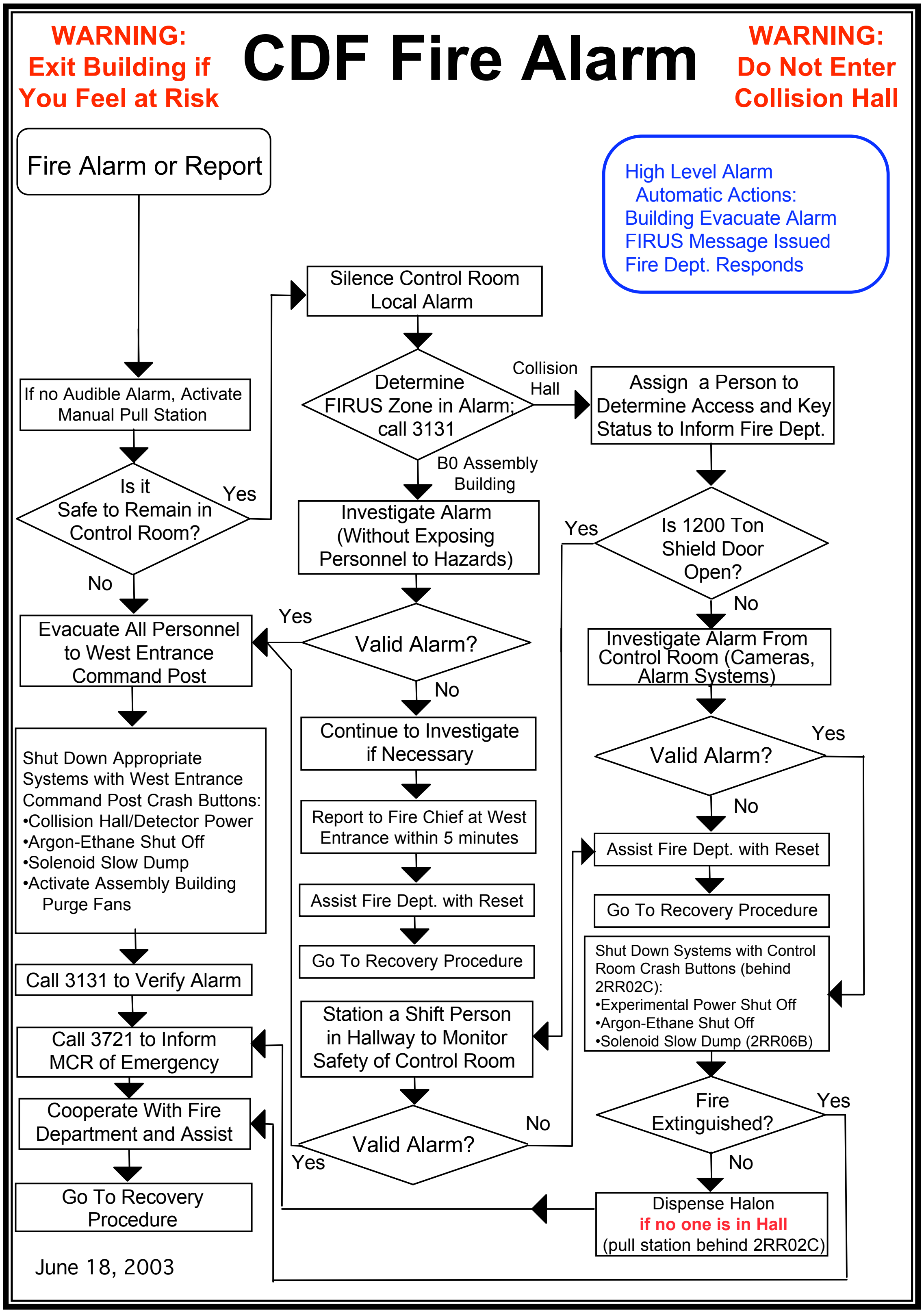
I have deleted a lot of duplicates, so if a plot set you're looking for is no longer there, it still exists, but possibly under a slightly different name.

Some of the other plots that might be useful are: RF & Abort Gaps (abort gap losses correlated with RF changes), Tev Shot (progress of a shot in the Tevatron), and D0 Dipole/Quadrupole Pots (abort gap losses correlated with movement in the D0 Roman pots. D0 actually has 16 quadrupole Roman pots, so if you want to see them all, take the D0QuadPot set and change P1 to P2, A1, or A2). Try them out!

Let me know if you have any questions or comments.
--Paul

# Emergency Response Procedures (ERPs)





# CDF Tornado/Severe Weather Alarm

When Warning is Issued:
- DAQ Ace: pause the run
- Monitoring Ace: hit the “End of Store” button on the HV control panel on VNODE1

↓

Take Emergency Pager

↓

Proceed Immediately to the Tornado Shelter in the Stairwell

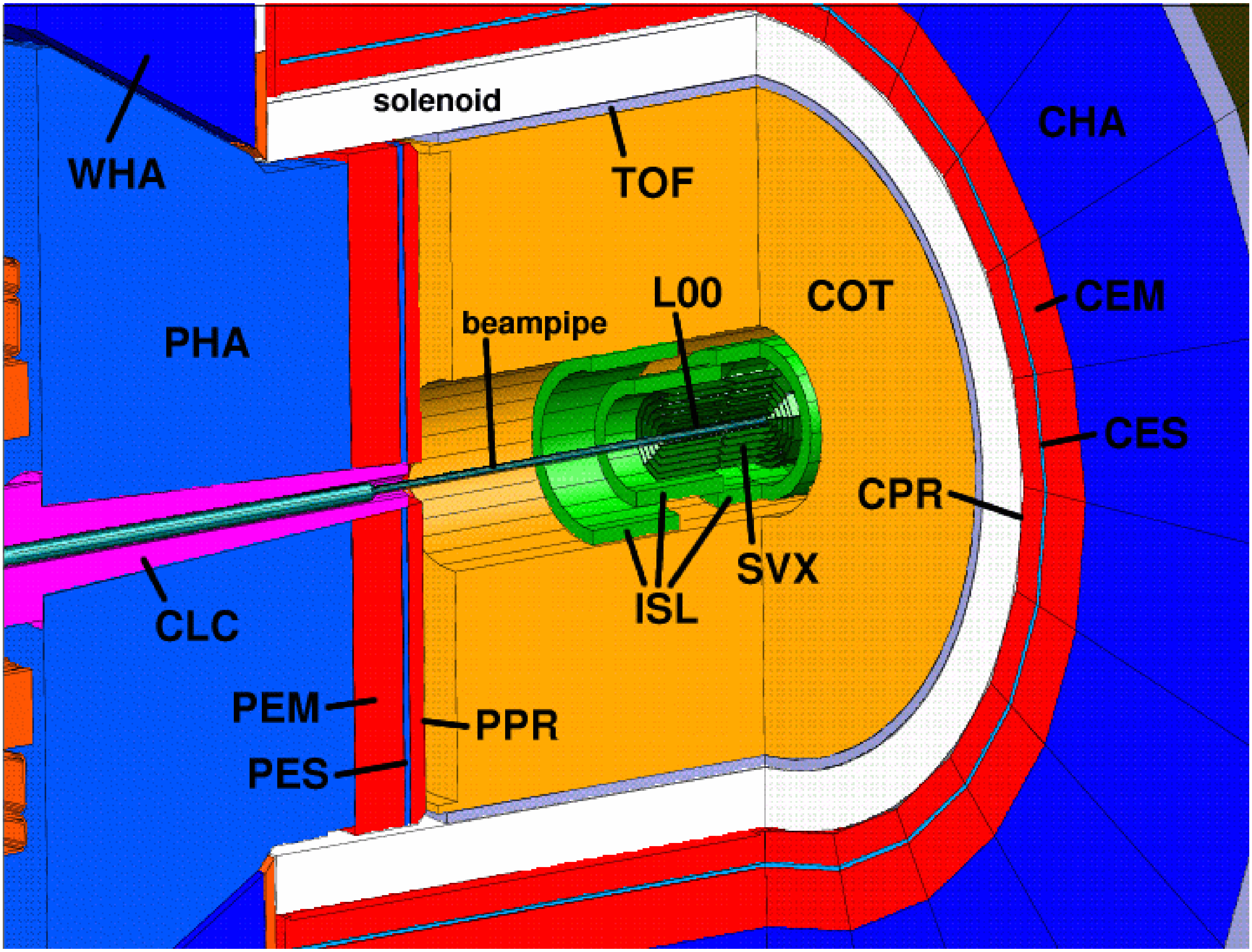
↓

When “All Clear” is Given Notify People on the Notification Call List if Necessary

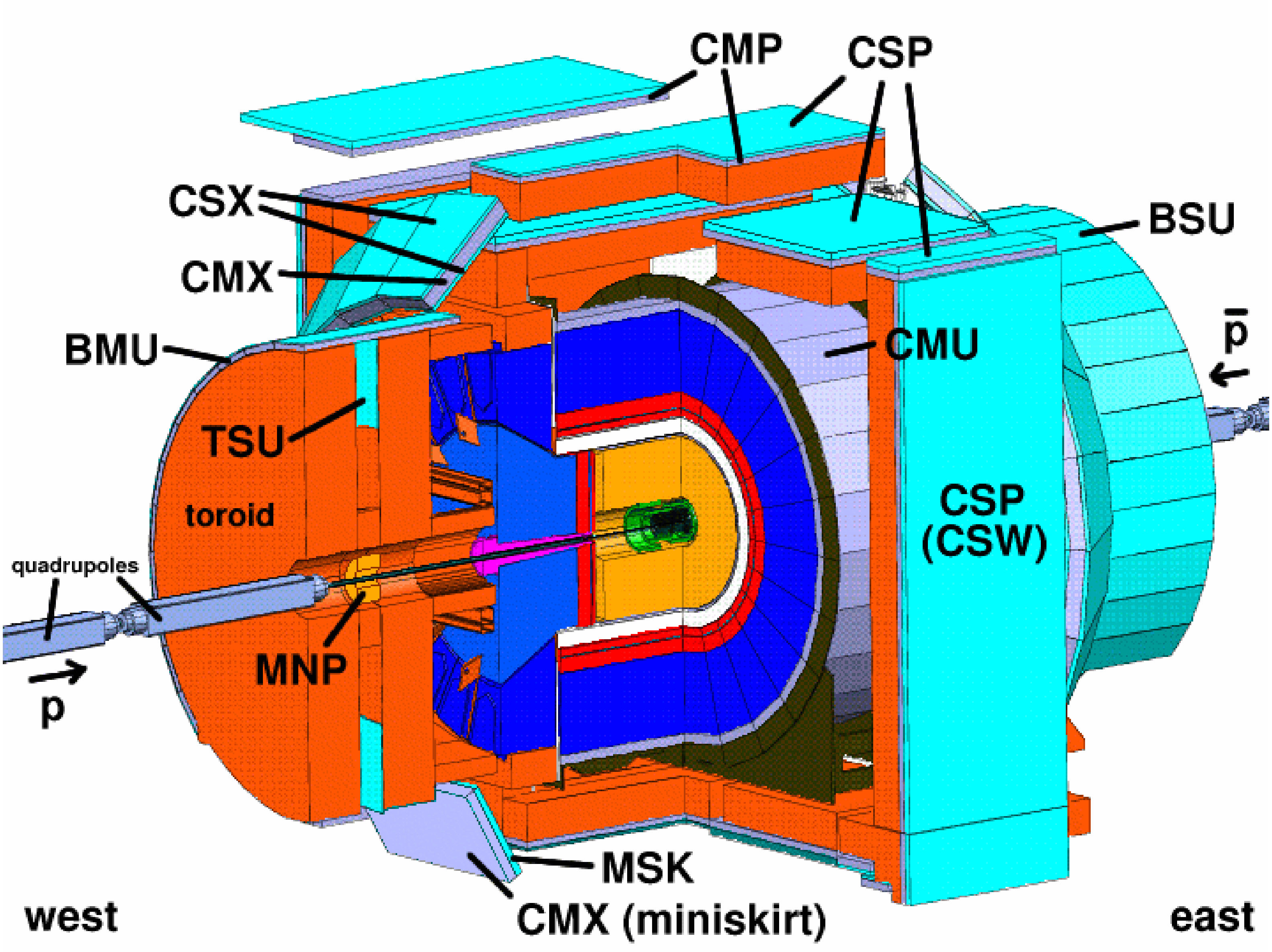
April 21, 2004

# An Ace's Guide to the CDF Run II Detector

This is designed to provide a basic guide to the CDF Run II detector. Most of the information is taken from the TDR; since there are, of course, changes in the final design from the TDR, I've tried to confirm the information I have with more recent sources. I can't guarantee that I've always been succesful in this, however.




**CDF Inner Detector (cutaway view)**




**CDF Detector (cutaway view)**

*[The picture I used as the basis for this, which I got from the [CDF Drawings page](), is much more accurate than the "official" CDF Run II upgrade picture located on [the Run II upgrade page]() -- it has the CLC, TOF, CES, BMU/BSU, and CMP upper north correct, no WSU or second layer of scintillators in TSU, and correctly has the top east wedges of CMX missing. I still had to make a fair number of modifications, most notably adding MNP and correcting for the fact that the MSK scintillators are only on the inner side. The one question I have about this picture is the overhang of CSP over CMP in the upper-north part. I can't find any reference that doesn't imply that CMP and CSP cover the same area. Of course, I can't find any reference that proves that the overhang is* wrong, *either. For what it's worth, the Event Display has no overhang, but who knows if that's correct?]*

## The CDF coordinate system

The following coordinates are used to describe the location of things in CDF:
z: Distance along the beamline. +z is the direction of proton travel (east) and -z is the direction of pbar travel (west). z=0 is the interaction point (IP).
r: Radial distance from the beamline.
theta: Polar angle from the beamline. theta=0 is the +z direction, theta=90 degrees is straight up, and theta=180 degrees is the -z direction. Typically eta is used instead of theta.

eta: Psuedorapidity. eta is defined as -ln(tan(theta/2)), so particles perpendicular to the beamline have an eta of 0. The beamline itself has an eta of +infinity in the +z direction and -infinity in the -z direction. theta = +/- 45 degrees corresponds to eta = +/- 0.88.
phi: Azimuthal angle around the beamline. North is phi=0, up is phi=90 degrees, south is phi=180 degrees, and down is phi=270 degrees.
x,y: x and y are also used occasionally. +x is north (towards the outside of the Tevatron ring) and -x is south; +y is up and -y is down.

Note that with a few minor exceptions, CDF is left-right symmetric, and with a few more exceptions (principally CMP) it is also cylindrically symmetric.

Many components in CDF are segmented into 15-degree wedges in phi. These wedges are numbered with 0 at phi=0 and proceeding in the +phi direction. Usually, a "wedge" refers to a given phi segment on a given side of the detector; for example, wedge 0E refers to the wedge from 0-15 degrees phi on the east side of the detector, and wedge 0W would refer to the wedge from 0-15 degrees phi on the west side of the detector.

# The detector components

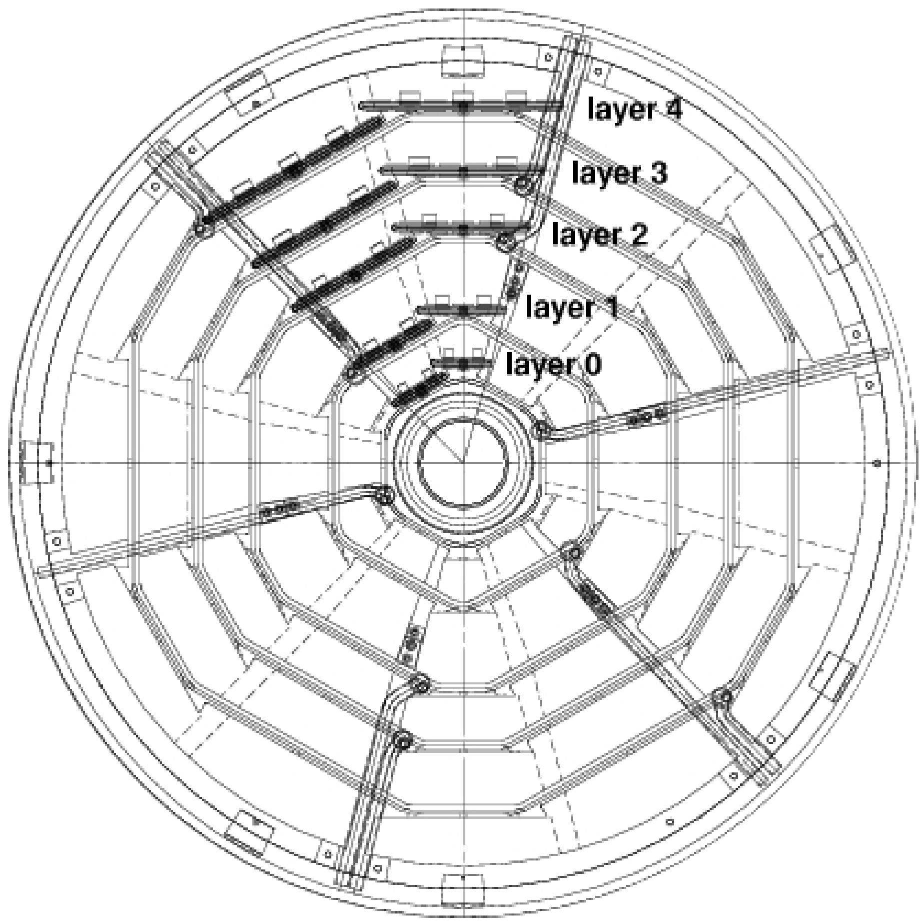
## *Silicon: SVX, L00, ISL*

### **SVX**: Silicon Vertex Detector

*Note:* SVX is often called SVX II to distinguish it from its Run I predecessors, SVX and SVX'.

*Purpose:* High-precision tracking and secondary vertex detection at inner radii.
*Location:* Outside of Layer 00, extending from r=2.1 cm to r=17.3 cm. Covers |eta| <= 2.0.
*Detector type:* Double-sided silicon microstrip detector. Strips are aligned axially on one side, with 90-degree stereo on the other side for layers 0, 1, and 3 and small-angle stereo (1.2 degrees) on the other side for layers 2 and 4.
*History:* SVX II is a replacement for the silicon detectors used in Run I (SVX and SVX'), featuring greatly expanded coverage, full stereo capabilities, and an approximately 9-fold increase in readout channels.
*Layout:* 360 half-ladders, organized into six bulkheads in z (three barrels each with a bulkhead on either side), 5 layers in r, and 12 wedges in phi. Ladders in adjacent wedges overlap slightly, to provide full coverage. The individual ladders get wider in successive layers; layer 0 (the innermost layer) has 256 strips on the axial side of each ladder, while layer 4 (the outermost layer) has 896 strips on the axial side of each ladder.

A note on SVX terminology: A "half-ladder", the basic readout unit of the detector, consists of two silicon sensors bonded together end-to-end, with a hybrid at the end of each side (top and bottom) to read out that side. Two half-ladders placed end to end (with the hybrids on the outside) make a ladder (there is one ladder per barrel per layer per wedge). Each hybrid is read out at the corresponding bulkhead. To make things confusing, "ladder" is often used to refer to a single half-ladder. The side of a ladder with axial strips is typically referred to as the "phi side" (since this side reads out a coordinate in phi), and the stereo side is referred to as the "z side".



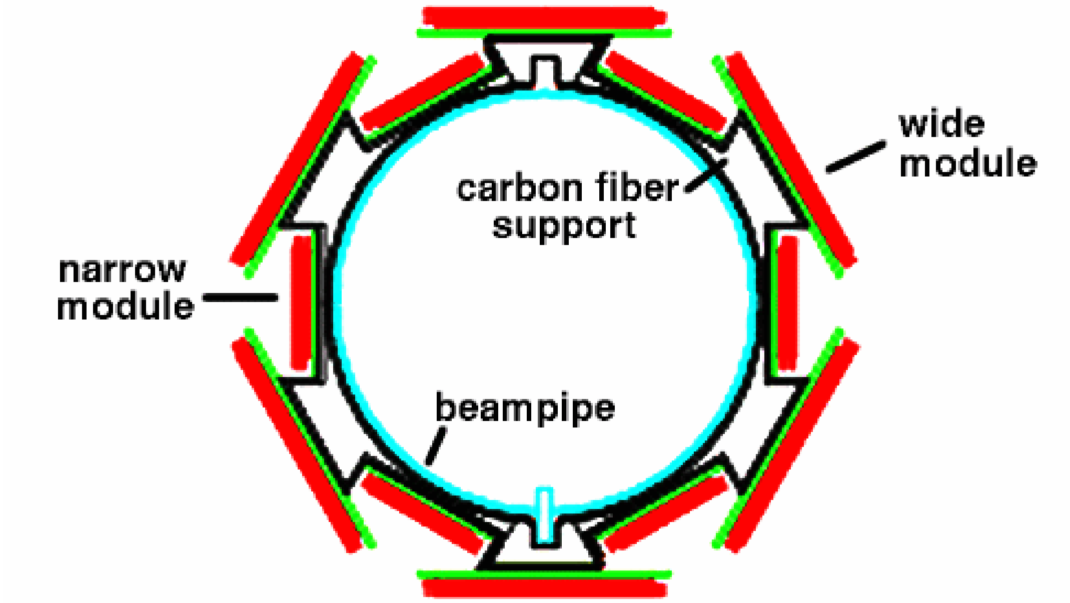

**SVX bulkhead, end view** (showing two wedges installed)

## **L00**: Layer 00

*Purpose:* Improved precision of track measurements and tagging efficiency. Layer 00 also serves as insurance against the loss of the innermost layer of SVX II (layer 0) to radiation damage.
*Location:* Immediately outside the beampipe, at a radius of approximately r=1.6 cm. Covers |eta| <= 4.0.
*Detector type:* Single-sided silicon microstrip detector.
*History:* New for Run II (proposed as part of the beyond-the-baseline proposal).
*Layout:* 72 modules in one layer, with 6 modules in z and 12 staggered wedges in phi. 6 wedges are "narrow" modules at a radius of r=1.35 cm, and 6 wedges are "wide" modules at a radius of r=1.62 cm. The narrow and wide modules overlap for full coverage.

Similar to SVX ladders, each module consists of two silicon sensors bonded together end-to-end. The narrow modules are 256 strips wide and the wide modules are 512 strips wide; only half of these strips are read out (128 readout strips for narrow modules, 256 readout strips for wide modules). However, unlike in SVX, the readout hybrids are located outside of the tracking volume (one group on the west side to read out the west modules, and one group on the east side to read out the east modules) and connected to the sensors by a fine-pitch cable. Three narrow modules are read out by a single (3-chip) hybrid, while each wide module is read out by a single (2-chip) hybrid, for a total of 48 hybrids. (Thus, tools which look at the data, such as SVXMon, will show the 72 L00 modules, but tools which look at the condition of the detector, such as IMON, will show the 48 L00 hybrids.)

Why is it called Layer 00? The innermost layer of SVXII is already called "Layer 0", so in order to clarify that this was really the innermost layer, it was called "Layer 00".

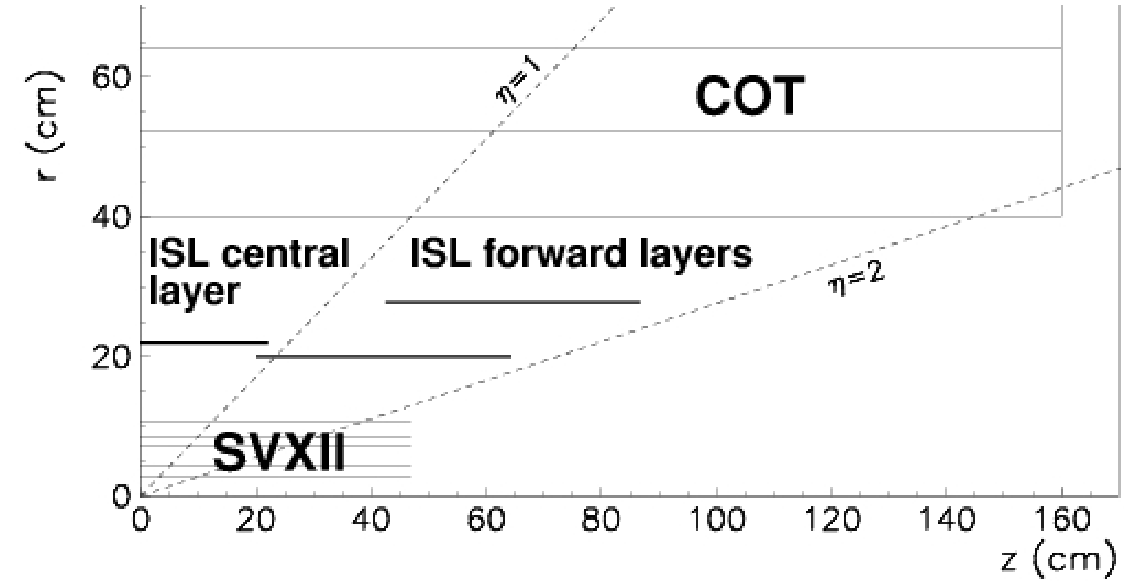



**L00, end view**

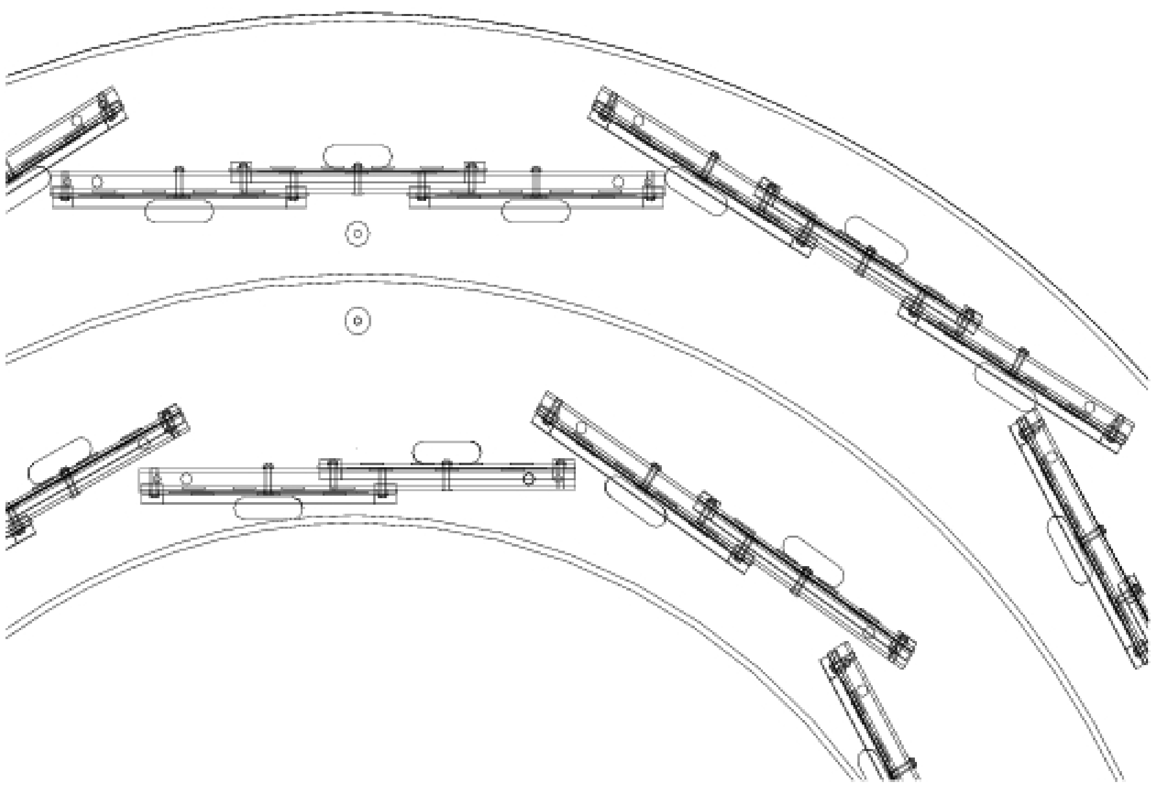
## **ISL**: Intermediate Silicon Layer

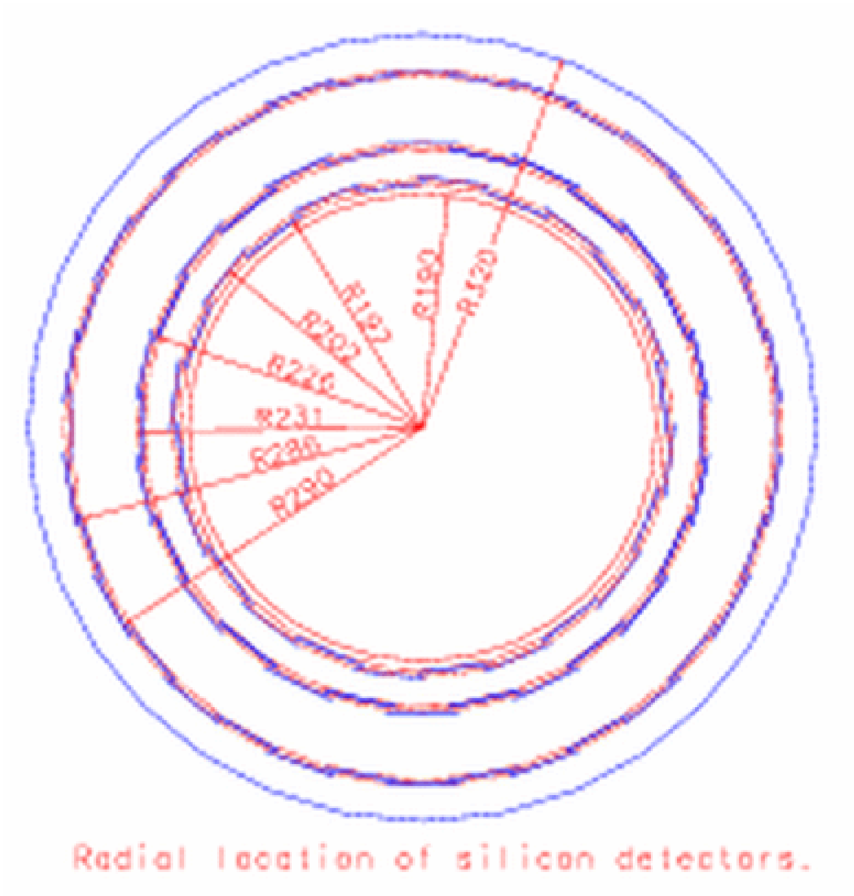
*Purpose:* In the central region, provides enhanced linking of tracks between SVX II and COT. In the plug region, where COT coverage is incomplete, provides improved silicon-only tracking capabilities.
*Location:* Between SVX II and COT. Central layer is at r=22 cm and forward/backward layers are at r=20 cm and r=28 cm. The central layer covers |eta| < 1.0 and the forward/backward layers cover 1.0 < |eta| < 2.0.
*Detector type:* Double-sided silicon microstrip detector (axial on one side, small-angle stereo on the other side).
*History:* New for Run II.
*Layout:* 296 total half-ladders. The central layer, in the central barrel, contains 56 ladders in two bulkheads and 28 wedges in phi. The two forward/backward layers, in the two outer barrels, contain 240 ladders in 4 bulkheads (2 per side) and 12 wedges in phi. Each wedge contains two ladders side-by-side for the inner forward layer (24 per bulkhead), and three ladders side-by-side for the outer forward layer (36 per bulkhead). Each ladder has 1024 strips on the axial side and 768 strips on the stereo side; only half of these are actually read out (512 axial, 384 stereo).

ISL ladders are very similar to SVX, except each half-ladder consists of three silicon sensors bonded end-to-end with a single double-sided hybrid which reads out both sides of the silicon. The hybrids do not lie on top of the silicon as they do for SVX half-ladders, but are rather attached at the end.




**ISL position, side view**





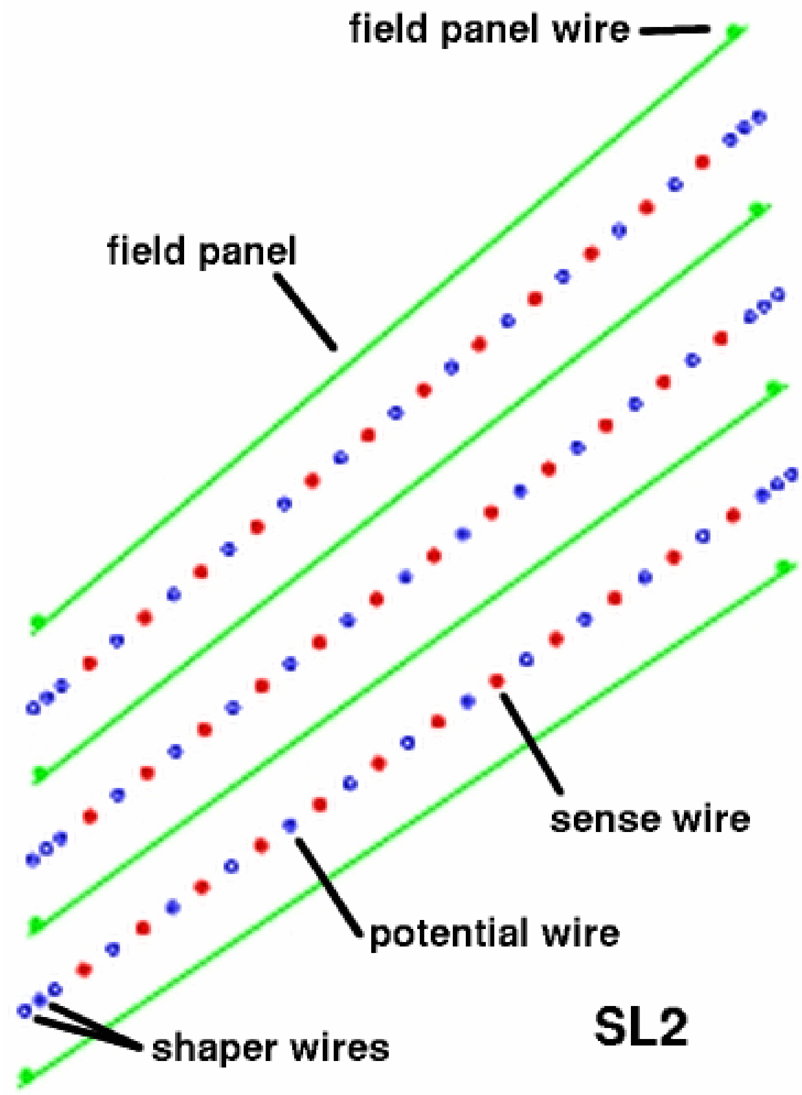

**Section of ISL forward bulkhead, end view**

*[The image on the left is from the TDR, and the one on the right is from CDF Note 4832 on the ISL spaceframe. As you can see, they're somewhat different on the geometry -- the TDR diagram has these groups of 2s and 3s, while the spaceframe diagram has them all evenly spaced. I asked Steve Nahn about this, and looked at the master diagram in the silicon lair, and of course they gave different answers (left and right, respectively). Hmm.]*

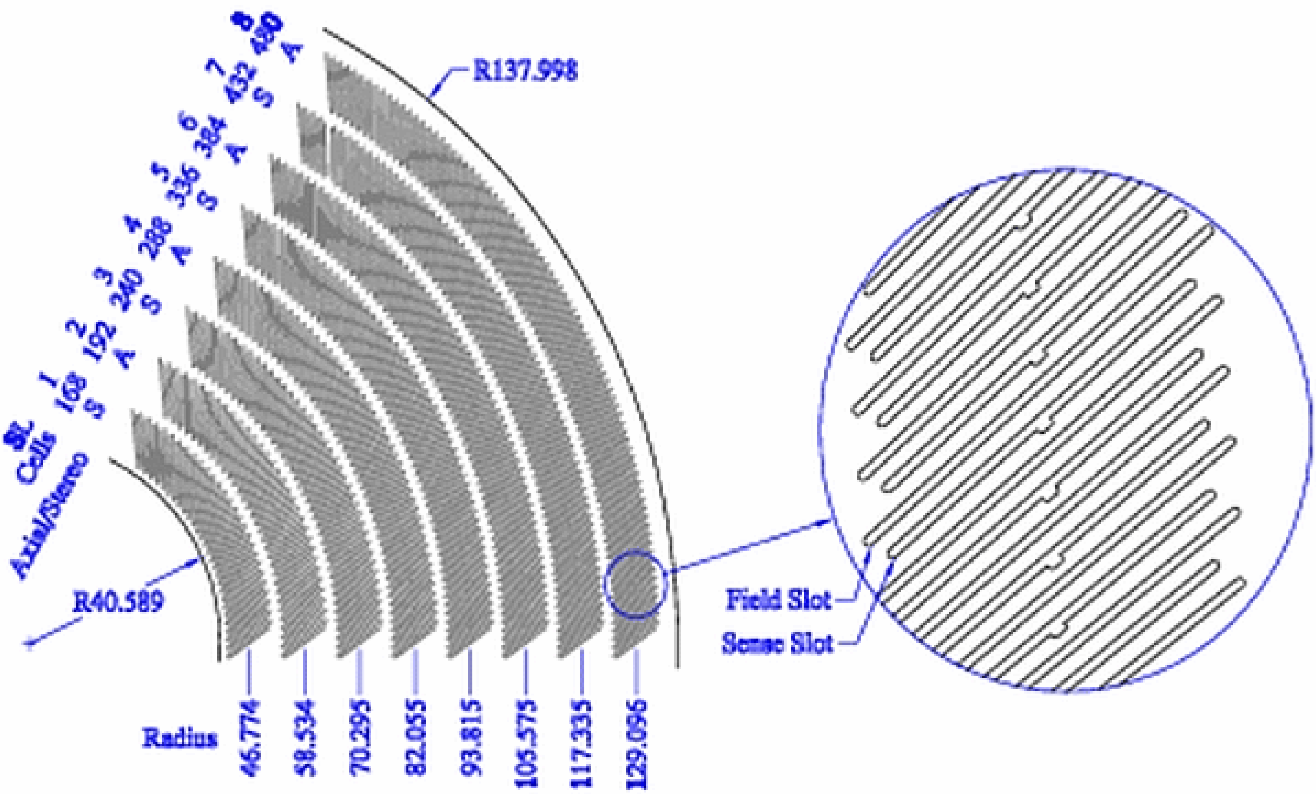
## **COT**: Central Outer Tracker

*Purpose:* General-purpose tracking in the central regions of the detector.
*Location:* Outside of silicon tracker, from r=40 cm to r=137 cm. Covers |eta| <= 1.0.
*Detector type:* Open-cell drift chamber with argon-ethane gas in a 50/50 mixture.
*History:* Replaces the Run I Central Tracking Chamber (CTC), and features a greater number of sense wires (approximately 5x more), enhanced stereo coverage, and faster drift times.
*Layout:* 2520 cells, divided into eight superlayers. The number of cells in each superlayer ranges from 168 for SL1 to 480 for SL8. Superlayers 2, 4, 6, and 8 are axial (wires parallel to the beam) while superlayers 1, 3, 5, and 7 are at a small stereo angle (2 degrees).

Each cell has a wire plane containing 12 sense wires and 13 potential wires, with two additional shaper wires at either end. Wire planes are separated by gold-on-Mylar field panels with stainless steel wires at either end. Cells are installed at a 35-degree Lorentz angle.




**Cross-sectional view of some COT cells** (SL2)




**COT endplate** (section). Slots for field plates and wire planes alternate.

## **TOF**: Time-of-Flight Detector

*Purpose:* Time-of-flight information to enhance particle identification abilities in the central detector, especially for improving K-pi discrimination.
*Location:* Outside of COT, at an approximate r of 140 cm.
*Detector type:* Scintillator read out by PMTs via lightguides.
*History:* New for Run II (part of the beyond-the-baseline proposal).
*Layout:* 216 bars of scintillator, each running the length of COT, arranged cylindrically, with a PMT at each end of each bar. PMTs 0-215 are on the east side and 216-431 are on the west side. The bars have a trapezoidal cross-section to minimize empty space between them.

*[Is a picture necessary here? Probably not.]*

## Solenoid

*Purpose:* Provides the magnetic field for tracking in the central detector.
*Location:* Between TOF and CEM.

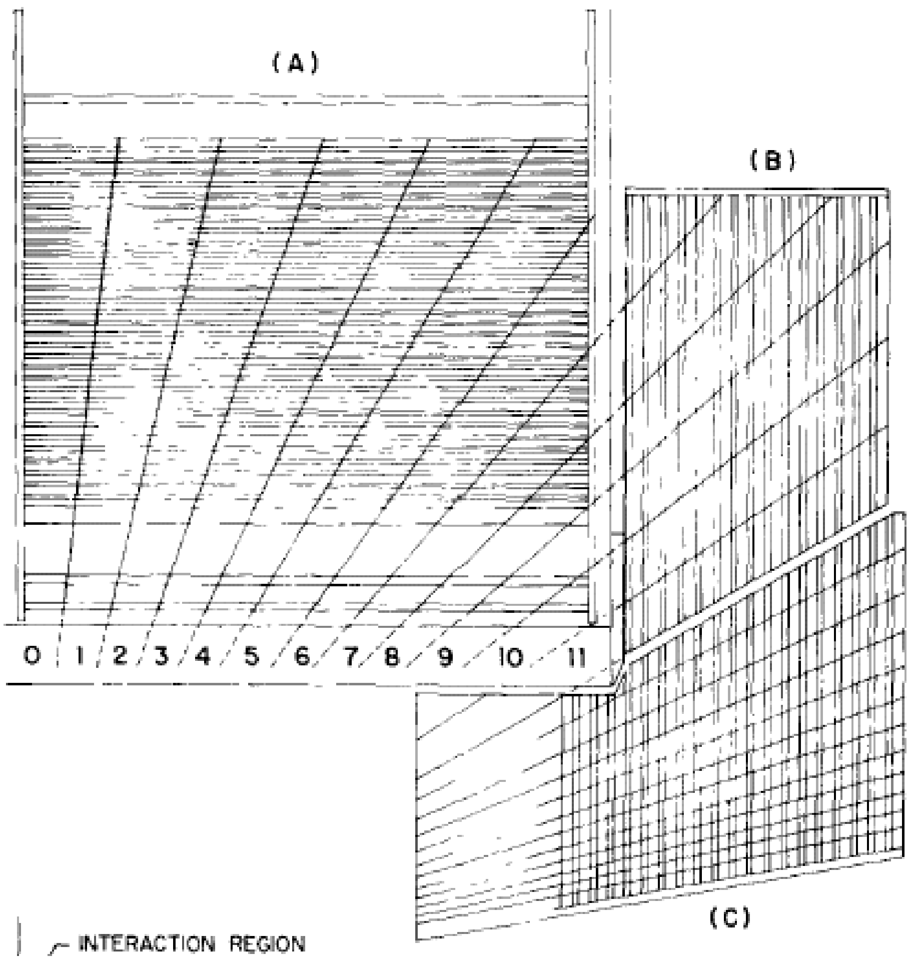
The superconducting solenoid is made of an aluminum-stabilized NbTi conductor. It can operate up to 1.5 Tesla but is typically used with a current of 4650 amps and a field of about 1.4 Tesla. The solenoid is contained within a cryostat where it is cooled by liquid helium.

## ***Central Calorimeter: CEM, CHA, WHA***

## **CEM**: Central Electromagnetic Calorimeter

*Purpose:* Energy measurement of electromagnetic showers in the central detector.
*Location:* Between the solenoid and CHA.
*Detector type:* Pb/scintillator sampling calorimeter, 31 layers deep.
*History:* The central calorimeter (CEM, CHA, WHA, as well as the central ShowerMax chambers CES, CPR, CCR) is largely unchanged from the beginning of Run I except for upgraded electronics to handle the higher luminosities of Run II.
*Layout:* 478 towers total, organized into 24 wedges in phi and 10 tower groups in eta on each side. Towers 8E and 9E in wedge 5 are removed for cryogenic utilities for the solenoid. Each tower is read out by two PMTs, one at the low-phi side of the tower, and one at the high-phi side. These are typically called "left" and "right", respectively, with the directions defined as with the wedge upright, looking from z=0 towards the wedge. (Thus, for east wedges, the "left" PMT is on the low-phi side and the "right" PMT is on the high-phi side; for west wedges, it's the other way around.)

*[The CEM paper also seems to imply that tower 7E in wedge 5 might be different as well, but is not at all clear on the details. Something definitive here would be nice.]*




**CEM/CHA/WHA coverage** (side view).

*[This diagram still needs improvement -- for starters, the plug needs to be cropped out, since this is the Run I plug depicted here. The diagram is a little confusing with respect to CHA, since it seems to imply that there are 9 CHA towers (0-8), but everything else (e.g. consumer plots and the voltage monitoring) indicates only 8 CHA towers (0-7).]*

## **CHA**: Central Hadronic Calorimeter

*Purpose:* Energy measurement of hadronic showers in the central detector.
*Location:* Outside CEM.

*Detector type:* Fe/scintillator sampling calorimeter, 32 layers deep.
*History:* Unchanged since Run I.
*Layout:* 384 towers total, organized into 24 wedges in phi and 8 tower groups in eta on each side. Each tower is read out by two PMTs.

*[For CHA wedge 5E, towers 4-7 are missing their right PMT. Is this also because of the cryogenic chimney, or for some other reason? Sources are unclear.]*

## **WHA**: Endwall Hadronic Calorimeter

*Purpose:* Extension of hadronic calorimeter coverage to the endwall region.
*Location:* Along the endwall outside of the plug.
*Detector type:* Fe/scintillator sampling calorimeter, 15 layers deep.
*History:* Unchanged since Run I.
*Layout:* 288 towers total, organized into 24 wedges in phi and 6 tower groups in eta on each side. Each tower is read out by two PMTs.

The calorimeters use the canonical CDF wedge numbering scheme, but also use a uniform tower numbering scheme, where towers 0W and 0E are closest to the interaction point and each tower covers approximately 0.11 in eta. Thus, CEM contains towers -9W to 0W and 0E to 9E, CHA contains towers -7W to 0W and 0E to 7E, and WHA contains towers -11W to -6W and 6E to 11E. (Note that the eta coverage of CHA and WHA overlaps somewhat.)

# ***Central ShowerMax: CES, CPR, CCR***

*[Documentation on CES is very scarce and CPR/CCR essentially nonexistent. Of course, we're dealing with 20-year-old systems here, so I suppose I shouldn't be surprised.]*

## **CES**: Central E-M ShowerMax chamber

*Purpose:* High-precision position measurements at shower maximum to provide track linking ability and transverse shower profiles to improve particle identification.
*Location:* Within CEM wedges, approximately 6 radiation lengths deep (at the expected shower maximum of particles in the EM calorimeter).
*Detector type:* Strip and wire chamber, with ? gas.
*History:* Unchanged since Run I.
*Layout:* 48 modules total, 24 on each side, one for each CEM wedge. Each module contains 32 wires parallel to the beam axis and split in the middle for a total of 64 wire readout channels per module, and 128 strips. *[The strip layout is unclear. I would naively guess that they're perpendicular to the wires, but I can't actually find a source that comes out and says so.]*

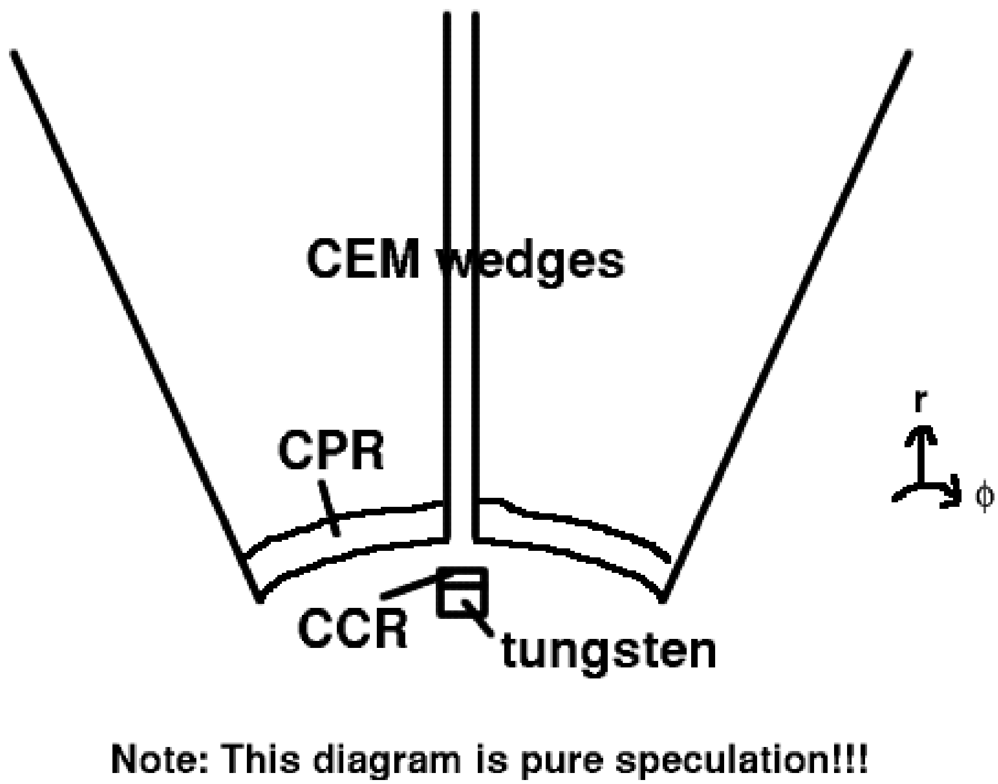
## **CPR**: Central Pre-Radiate chamber

*Purpose:* Preshower measurements for enhanced discrimination between electrons and pions, and improved photon measurements.
*Location:* On the inside surface of CEM wedges.
*Detector type:* Wire chamber, ?.
*History:* Unchanged since Run I.
*Layout:* ???

## **CCR**: Central Crack Chamber

*Purpose:* To provide some coverage for particles which would otherwise fall into the gaps between calorimeter wedges.
*Location:* In the gaps between CEM wedges.
*Detector type:* Wire chamber, behind 12 radiation lengths of tungsten.
*History:* Unchanged since Run I.
*Layout:* ???

*[I don't even know where CCR* is*: is it physically between the wedges of CEM? inside the inner radius? outside the outer radius? does it span the whole depth of CEM? part? This picture represents my best guess:*




*...but this guess is mostly based on the CPR/CCR Run IIb upgrade, which is something I can actually find information on. Is this upgrade actually going to happen, by the way? If so, maybe I shouldn't worry too much about getting the details right here for CPR/CCR.]*

## *End plug: PEM, PHA, PES, PPR*

### **PEM**: Plug Electromagnetic Calorimeter

*Purpose:* Energy measurement of electromagnetic showers in the plug region of the detector.
*Location:* Outside the barrel end of COT, one plug on each side. Covers 1.1 < |eta| < 3.6.
*Detector type:* Pb/scintillator sampling calorimeter, 23 layers deep. (The first layer is actually read out separately and used as PPR; see below.)
*History:* The plug calorimeters (PEM, PHA) are new for Run II. They replace the Run I gas-based calorimeters used in the plug region, which would have been too slow for the higher speed in Run II. They also have more complete coverage in theta (extending to 3 degrees rather than 10 degrees as in Run I), eliminating the need for a separate forward calorimeter system as used in Run I.
*Layout:* 480 towers per plug, organized into 12 tower groups in eta. The innermost 4 tower groups (largest eta/smallest theta) each have 24 wedges in phi (each tower covers 15 degrees); the outermost 8 tower groups each have 48 wedges in phi (each covering 7.5 degrees).

*[Diagram of PEM/PHA coverage to go here.]*

## **PHA**: Plug Hadronic Calorimeter

*Purpose:* Energy measurement of hadronic showers in the plug region of the detector.
*Location:* Beyond PEM. Covers 1.2 < |eta| < 3.6.
*Detector type:* Fe/scintillator sampling calorimeter, 23 layers deep.
*History:* New for Run II (see above).
*Layout:* 432 towers per plug, organized into 11 tower groups in eta. The arrangement is the same as for PEM except the outermost tower group (smallest eta/largest theta) does not exist (this area is already covered by WHA).

The tower numbering scheme is an extension of the numbering used in the central calorimeter. The west PEM covers towers -21W to 10W and the east PEM towers 10E to 21E. The west PHA covers towers -21W to 11W and the east PHA towers 11E to 21E.

## **PES**: Plug Electromagnetic ShowerMax detector

*Purpose:* Like CES, provides precision measurements of shower positions and improved ability to separate electrons, pions, and photons.
*Location:* Within PEM, approximately six radiation lengths deep.
*Detector type:* Scintillator strips.
*History:* New for Run II.
*Layout:* 3200 scintillating strips per plug, divided into eight 45-degree wedges per plug with two layers of 200 strips each. In one layer, the strips are oriented parallel to one side of the wedge and in the other layer, parallel to the other side. In each wedge, the strips are divided into upper (1.13-2.60) and lower (2.60-3.50) regions in eta.

## **PPR**: Plug Pre-Radiate detector

*Purpose:* Like CPR, provides enhanced ability to discriminate between electrons and pions.
*Location:* First scintillator layer of PEM.
*Detector type:* Scintillator tiles.
*History:* New for Run II.
*Layout:* Same as PEM.

In iFix, **PSH** (Plug ShowerMax) refers to PES+PPR.

# ***Muon chambers: CMU, CMP, CMX, BMU***

*[The muon chamber and scintillator sections is still in progress -- I need to track down the rest of the papers on the muon systems. Once I'm done, the information here should be more complete. Expert information is still probably needed in a lot of places, though.]*

## **CMU**: Central Muon Chambers

*Purpose:* Detection of muons in the central detector region.
*Location:* At the outside edge of CHA wedges. Covers |eta| < 0.6.
*Detector type:* Wire chamber operated in proportional mode.
*History:* Largely unchanged since Run I. The major change for Run II is to run the drift chambers in proportional mode rather than limited-streamer mode (which would be too slow for Run II).

*Layout:* Total of 2304 cells, organized into 144 modules. There are 3 modules per CHA wedge per side. Each module is composed of 16 cells arranged in 4 radial layers of 4 cells each. Each cell contains one sense wire, and runs the length of the wedge on one side.

*[Diagram of CMU location to go here.]*

## **CMP**: Central Muon Upgrade

*Purpose:* Confirmation of CMU tracks. Since CMP is behind more material, CMP hits have a higher signal-to-background ratio and increase the trigger efficiency of the CMU/CMP combination.
*Location:* Along the walls, floor, and top surface of CDF. Covers |eta| < 0.6.
*Detector type:* Wire chamber operated in proportional mode.
*History:* CMP was added during Run I. In Run II, the coverage was completed by filling in several gaps in the original instrumentation.
*Layout:* Total of 1068 cells, arranged in 4 layers. There are 77 stacks along the top, 65 along the bottom, 62 on the north wall, and 63 on the south wall. *[These numbers come from the muon channel maps. The TDR claims 1076 cells, although it doesn't have a breakdown of individual sides. As usual, an explanation here would be nice.]*

Unlike the other detectors in CDF, which are all (mostly) cylindrically symmetric around the beampipe, CMP is roughly box-shaped. This is because CMP uses the magnet return yoke steel as absorbing steel, along with some additional pieces of steel to fill gaps in the existing steel.

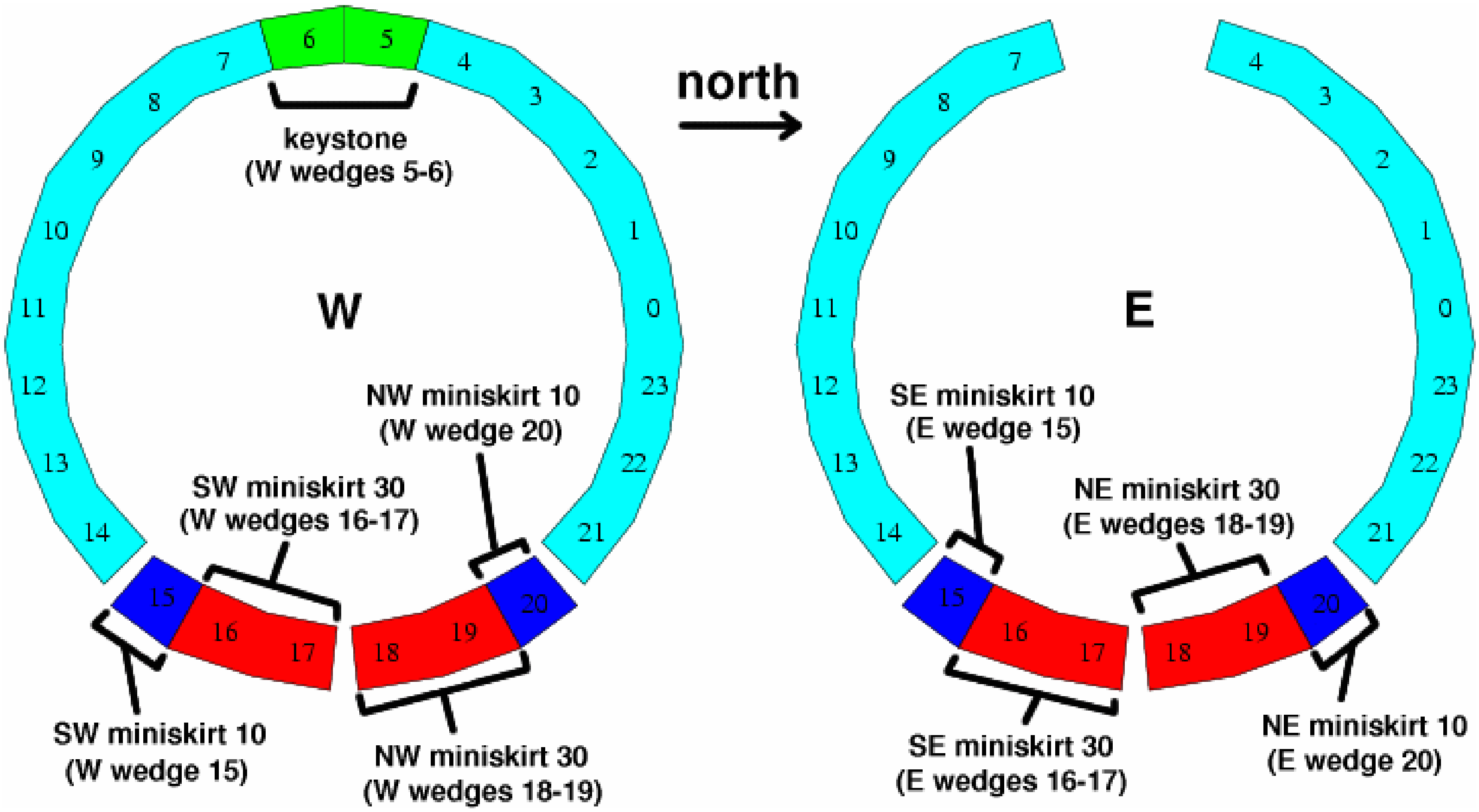
*[Diagram of CMP coverage to go here.]*

## **CMX**: Central Muon Extension

*Purpose:* Extension of central muon coverage to eta = 1.0.
*Location:* A truncated cone covering the area between BMU and CMP. Covers 0.6 < |eta| < 1.0.
*Detector type:* Wire chamber operated in proportional mode.
*History:* Most of CMX was constructed during Run I. Run II added the missing wedges in the miniskirt and the west keystone (see below). *Layout:* CMX is divided into two parts. The upper conical section covers the upper 270 degrees in phi (wedges 0-14 and 21-23 in the normal wedge numbering system). The lower 90 degrees in phi (wedges 15-20) has slightly different geometry due to the floor; this section is called the "miniskirt".

The conical section contains 1632 cells, 864 on the west and 768 on the east side, divided into 18 wedges in phi (each covering 15 degrees). On the east side, the top two wedges (5 and 6) are missing due to space for the cryogenic utilities for the solenoid. (On the west side, these wedges are new for Run II and are called the "keystone".)

The miniskirt contains a total of 576 cells, 288 per side. The miniskirt has a slightly different geometry; it is not conical like the rest of CMX, but has a planar "fan" geometry. The wedge division is also somewhat different from the rest of CMX. The outermost wedges (15 and 20) are usually referred to as "miniskirt 10" for that quadrant, while the centermost wedges (16-19) are grouped into two pairs and called "miniskirt 30". (These names are because they cover 10 and 30 degrees in phi, respectively *[at least that's the reason I can think of -- it would be nice to have confirmation of this point]*.)




**CMX wedge layout, end view**

## **BMU**: Barrel Muon Chambers

*Purpose:* Muon detection in the forward region.
*Location:* On the outside of the toroids. Covers 1.0 < |eta| < 1.5.
*Detector type:* Wire chamber operated in proportional mode.
*History:* BMU is new for Run II. It replaces the Run I Forward Muon system (FMU), in which the toroids were farther out from the central detector and energized, with drift chambers installed on the faces of the toroids.
*Layout:* 1728 chambers total, 864 per toroid, arranged into 4 layers with 216 chambers per layer. Each chamber occupies 1.25 degrees of phi; the bottom 90 degrees of the barrel are not covered due to the support structures for the toroids.

*[Might as well have a diagram for BMU, though it might be difficult to find.]*

## Toroids

*Location:* Outside the plugs.

The toroids in Run I were energized to provide tracking for forward muons. In Run II, they are no longer energized, but are used only to provide absorbing steel for the barrel muon detectors.

## ***Muon scintillators: CSP, CSW, CSX, MSK, BSU, TSU***

## **CSP**: Central Scintillator Upgrade
## **CSW**: CSP Wall Scintillators

*Purpose:* Fast timing and trigger counters for CMU/CMP muons.
*Location:* On the outside of CMP chambers.
*Detector type:* Scintillator tiles.
*History:* The north and south walls were outfitted in Run I, while the top and bottom are new for Run II. (See below.)
*Layout:* 269 tiles total. Each tile covers two CMP chambers in width and one-half chamber in length.

In iFix, CSP is divided into CSW (which refers to the parts of CSP on the north and south walls), and CSP (which refers to the parts of CSP on the top and bottom of the detector). This is because the CSP scintillators on the north and south walls were installed during Run I, while the CSP scintillators on the top and bottom are new for Run II. Consequently, they have different readout systems. Normally, however, the whole system is just referred to as CSP.

## **CSX**: Central Scintillator Extension

*Purpose:* Fast timing trigger counters for CMX muons (in the conical section).
*Location:* Both surfaces of CMX chambers.
*Detector type:* Scintillator tiles.
*History:* Installed with CMX during Run I.
*Layout:* Total of 272 tiles, with four tiles on either side of each CSX wedge. CSX Internal refers to the tiles on the inner side, and CSX External refers to the tiles on the outer side. CSX only covers the upper 270 degrees of CMX, not the miniskirt. That's what MSK is for.

## **MSK**: CMX Miniskirt Scintillators (also called MSX)

*[The miniskirt scintillators were probably the most difficult item for me to find information on, since it seems like every source says something different. It seems like CDF Note 6105 is the most useful source here, since it has the most recent date -- 12/18/02. Unfortunately, this note even has some internal contradictions.]*

*Purpose:* Fast timing and trigger counters for CMX muons (in the miniskirt section).
*Location:* Inner surface of CMX miniskirt chambers.
*Detector type:* Scintillator tiles.
*History:* New for Run II.
*Layout:* One tile on the inner surface of each CMX miniskirt chamber.

## **BSU**: Barrel Scintillator Upgrade

*Purpose:* Fast timing and trigger counters for BMU muons.
*Location:* Outer surface of BMU chambers.
*Detector type:* Scintillator tiles.
*History:* New for Run II.
*Layout:* 432 counters, 216 per side. Each tile covers two BMU chambers in azimuth (2.5 degrees in phi) and half of the length of each BMU chamber. BSU-Front covers the half closer to the interaction point, and BSU-Rear the further half.

## **TSU**: Toroid Scintillator Upgrade

*Purpose:* Additional triggering powers for forward muons.
*Location:* Inner face of the toroids.
*Detector type:* Scintillator tiles.
*History:* New for Run II.
*Layout:* 144 counters, 72 per side, each covering 5 degrees in phi, arranged in a circle.

Note: The original Run II plan called for an additional circle of 72 counters in each toroid at a closer radius, as well as another circle of 72 counters mounted on each endwall (this would have been the WSU -- Endwall Scintillator Upgrade). However, these proposals never made it into the final upgrade. You can still see the endwall counters in some drawings of CDF; in fact, the Run II upgrade drawing still shows these scintillator layers.

BSU+TSU are sometimes referred to as **ISU**, or the Intermediate Scintillator Upgrade. BMU+BSU+TSU makes the **IMU**, the Intermediate Muon Detector.

## **CLC**: Cerenkov Luminosity Counters

*Purpose:* Luminosity measurement of the beams at CDF.
*Location:* Surrounding the beampipe in the plug region.
*Detector type:* Gaseous Cerenkov light detector, using isobutane gas.
*History:* New for Run II. *[How were luminosity measurements made in Run I? Anyone know?]*
*Layout:* 48 cones per side, arranged in 3 layers of 16 cones each.

*[CLC diagram goes here]*

## Beampipe

The beampipe in the CDF region is divided into two sections. In the central region of the detector, the beampipe is made of beryllium with a 2.7 cm inside diameter and an 0.05 cm thickness. The length of the beryllium beampipe is 332 cm (slightly longer than the COT). At this point, the beryllium beampipe is connected by a flange to a stainless steel bellows pipe which runs to the low beta quadrupole magnets on either side. This bellows has a 5.1 cm inner diameter and a 6.1 cm outer diameter.

*[All of this information comes from the TDR, which admits that it is subject and likely to change. Final information about the beampipe is essentially impossible to find -- the only note I can find which even mentions the beampipe (CDF 5849) says that the drawings are "hard-to-find". It seems like that's the only source, though. (Note also that this document has a somewhat different description of the beampipe from the TDR.) I'd like to put a drawing here, but I'm not going to do so until I have authoritative information.]*

# ***Forward detectors: MNP, BSC, RPS***

## **MNP**: Miniplug Calorimeter

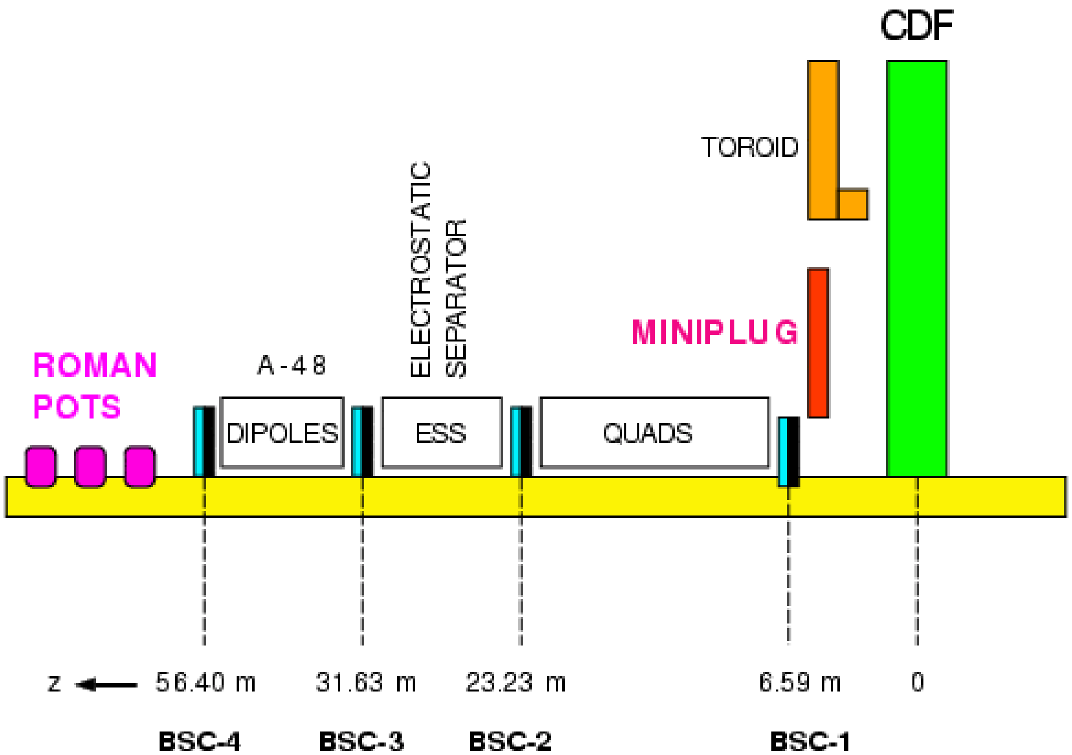
*Purpose:* Measurement of diffractive events and far forward particles. *Location:* Inside the central hole of the toroids. Covers 3.6 < |eta| < 5.2.
*Detector type:* Pb/liquid scintillator sampling calorimeter, 36 lead plates deep.
*History:* New for Run II.
*Layout:* Each plug is divided into 252 hexagonal cells, each with 6 fibers to read out the scintillator. Three cells make a "tower", for a total of 84 "towers" per miniplug.

*[MNP diagram goes here]*

## **BSC**: Beam Shower Counters

*Purpose:* Measurement of diffractive events; also provides beam loss information.
*Location:* Along the beampipe at various distances from the interaction point. There are four BSC stations (BSC-1 through BSC-4) on the west side and three BSC stations (BSC-1 through BSC-3) on the east side.

*Detector type:* Scintillator tiles. The tiles are rectangular with cutouts for the beampipe.
*History:* New for Run II.
*Layout:* BSC-1 stations have four tiles, each covering 90 degrees; BSC-2, 3, and 4 stations have two tiles each covering 180 degrees. The BSC-1 stations also are covered by a 3/8" lead plate to convert photons. Each tile is read out by one PMT.




**Location of BSC and RPS on the west side** (not to scale). The east side is the same except there is no BSC-4 station or Roman pots.

## **RPS**: Roman Pot Spectrometer

*Purpose:* Measurement of diffractive events.
*Location:* Three pots along the beampipe beyond BSC-4 on the west side, approximately 57m away from the interaction point.
*Detector type:* Scintillator fibers, plus one scintillator tile per pot for triggers.
*History:* Originally installed during Run Ic; retained for Run II.
*Layout:* 80 readout channels per pot (40 for fibers in the X-direction and 40 for fibers in the Y-direction).

The Roman pots are equipped with bellows which allow them to move from their "out" position away from the beampipe to their "in" position inside the beampipe approximately 10mm away from the beam. Roman pot 1 is the closest to B0 and pot 3 is the farthest away.

*[It would be nice to add some information on the beam halo counters and the beam loss monitors, too. The former are documented in CDF 5936; I'll add it in at some point. The latter, I don't know if there's any information easily available, though Rick Tesarek's e-log entry from 5/12/04 evening is a nice start.]*

# Image credits

- Main CDF cutaway and zoomed CDF cutaway pictures: originals from Pat Lukens' CDF drawings page, with labels added and some minor corrections made.

- SVX bulkhead picture: from TDR chapter 5, cropped and with labels added.
- L00 view: from Alan Sill's silicon upgrade overview, cropped appropriately
- ISL side and end pictures: from TDR chapter 6, cropped and with labels added; other ISL picture from CDF note 4832.
- COT pictures: from the COT NIM paper (citation below). Labels added to the cell picture.
- CEM/CHA/WHA coverage: from the NIM paper: "The CDF Central and Endwall Hadron Calorimeter", NIM PRA **267** (1988) 301-314.
- CMX wedges picture: from Camille Ginsburg's Muon Detector Pictures page, with miniskirt and keystone labels added.
- BSC/RPS location picture: from Michele Gallinaro's Forward Detectors page.

# References


- Overall Run II upgrade details, SVX, ISL, solenoid, plug, muon upgrades: The CDF II Collaboration, The CDF II Detector Technical Design Report, FERMILAB-PUB-96-390-E.
- Wedge numbering and labeling conventions: Steve Hahn's Run 2 Magic Decoder Ring page.
- L00: T. Nelson, The CDF Layer 00 Detector, CDF Note 5780.
- COT: COT group, A. Mukherjee, R. Wagner, CDF Central Outer Tracker, CDF Note 6267. Note that there are some differences between the design outlined in the TDR and this document; I've used this document as the authoritative source.
- BSC: A. Bhatti et al., The Beam Shower Counters for Run II, CDF Note 5247.

Previous ACEs have made a list of items a new ACE should learn during training and overlap shifts.

Have you...

```
For DAQ ACE
============

 1. Run Control (RC)
    a) Have you started RC(run control) from scratch?
    b) Do you know what actions are permitted in each RC state?
    c) Do you know how to check the status of a particular crate
from
       Replies and Acknowledgement window?
    d) Have you started AAA_COSMICS, AAA_SHOTSETUP, AAA_NOSILICON
and
       AAA_CURRENT run
       (after checking crates and trigger table from View/Edit Run
       Settings) or at least know how to do it?
    e) Do you know how to enable AUTOMATIC HRRs from "Error
Display"?
    f) Have you changed run configuration with "Run Settings"
window
       (specially you should know how to mask off
       trigger inhibit for a detector subsystem from this window,
change
       no. of files going to lookarea/tape,
       change trigger table, how to take a bad crate/card out of
run
       configuration, enable expert options, how to take a L3
subfarm
       out of run configuration, etc.)?
    g) You should be extra careful if you change any configuration
       settings in the sense that you should NOT save
       them as default.
    h) Do you know where we can see ErrorDisplay/ErrorLog? Do you
know
       where the log file is?
    i) Each time you suspect some detector configuration has
changed, you
       should start a new run
       (unless its unimportant as in case of BSU, TSU trips etc.).
    j) Do you know how to change L2 Busy timeout period when
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multiple
       RC's are accessing L2?

 2. DAQ Operation
    a) Did you read previous shift e-log/important notices before
coming
       your shift? Have You read the whiteboard?
    b) Have you ever read "Shot Setup Checklist"?
    c) Do you know how to page someone?
    d) Have you made an entry in the e-log?
    e) Have you reseted and recovered a particular crate after it
fails
       certain RC transition
       (both from xterm and run control)?
    f) Some critical crates cannot be reset without ending the run
or till
       the store lasts unless an expert
       asks you to do so(for example b0clc00, b0l2de00 etc.) Are
you fully
       aware of these crates?
    g) Have you reseted manually the particular EVB crate on the
1st
       floor?
    h) Do you know how to stop/start L3/EVB proxy?
    i) Have you cleaned up L3/EVB?
    j) Did you experience SHOT SETUP?
    k) Do you know that a "good" run should have at least 10 nb^-1
to be
       processed by offline farms otherwise
       you need to request them to process?
    l) Do you know how to react to various trigger inhibits due to
HV
       trips(specially for Silicon, Plug and CLC)?
    m) Remember to keep auto HRRs enabled specially while taking
data.
    n) Do you know how to recover from b0svx* failures? Do you
know
       when and how to reset silicon VRB crates?

 3. Calibration
    a) Do you know which calibration to do first? Which HVs need
to be
       ON/STNDBY/OFF for each calibration?
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        Tips : Please check which calibration is quiet time only
               calibration.

     b) Have you experienced all calibration and special runs?

        * CAL QIE
        * CAL LED
        * CAL XEF  (Did you switch XENON Flashers ON/OFF, located
                    instructions?)
        * CLC QIE
        * COT
        * MUON
        * TOF TAC
        * TOF QIE
        * BSC QIE
        * Roman Pot
        * SMX      (IMP: You should take SMX calibrations whenever
          Central/Plug crates are powercycled)
        * RICK'S RUN (Do you know what CO should do when we take
this run?)
        * PLUG LASER RUNS (Did you locate instructions, Laser fans
on the
          first floor?)

 3. Monitoring
     a) Do you know what is showed in L3 DISPLAY?
     b) Do you know what is showed in Trigger Rate Monitor
(specially
        trigger rates and deadtime)?
     c) Do you know where DPS(dynamic prescaling) button is?
     d) Do you know how to change prescale for a particular
trigger?
     e) Do you know what we can do with Ace control panel?
     f) Do you know what processes are listed in ProcMon, TevMon
and Voice
        alarm?
     g) Do you know how to restart Critical Processes monitored by
ProcMon?
     h) Do you know how to start and stop Level2 Alpha Minicom?
     i) Do you know what is monitored by PingMon/VxWorks System/Big
Brother
        monitors?
     j) Do you know how to "restart" Big Brother?
```

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    k) Do you know where we can see CS/L logging rate?
    l) Do you know what the Consumer Operator monitors?
    m) Do you know how to start consumer monitors/displays?
    n) Do you know to restart consumers everytime you restart Run
Control
       or change partition or change from data to cosmics mode?

For MONITORING ACE
===================

 1. Operation
    a) Did you read previous shift e-log/important notices before
coming
       your shift?
    b) Have you ever read "Shot Setup Checklist"?
    c) Do you know how to page anyone?
    d) Have you made entry in e-log?
    e) Have you ever experienced a Shot Setup?
    f) Do you know alarm and abort thresholds for detector
operation?
    g) Do you know where the ICICLE process is running and how to
       kill/start it?
    h) Have you located solenoid controls/PC and do you know its
password
       in case you need to reboot it
       (this happens sometimes when Icicle/other programs crash
and PC
        runs out of memory)?
    i) Do you know the password to log in to various VNODE PCs?
    j) Try to see correlations between HV trips and beam
conditions.
    k) Do you know who the Process System Shift Operator is and
where
       he/she normally sits?

 2. IFIX
    a) Have you used the GLOBAL ALARM SUMMARY page?
    b) Do you know how to bring up HV from the HV SUMMARY page?
    c) Do you know the highlighted status of HV on the HV SUMMARY
page
       (ie OFF/STNDBY/ON) only reflects the last transition issued
from
       the same PC and may not correspond to the actual state of
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the system?
       (The best way to judge the state of the system is to look
the min/max
         voltage bars and their colors or the numerical status
value.)
    d) Have you seen TRIGGER INHIBIT STATUS page and know how to
       enable/disable inhibits?
    e) How to get hold of these pages if you happen to close them
by
       accident?
    f) Do you know how to respond to process systems alarms
specially for
       silicon cooling?
    g) Do you know where clock crate is?
    h) Do you know when to start worrying about heartbeat alarms?

 3. SILICON SAFETY
    a) Do you know the silicon safety criterion during data-
taking?
    b) Have you located Silicon Cooling/Rack Power Crash Buttons?
    c) Do you know when to page silicon expert?
    d) Do you know how to react to pink cells in IMON?
    e) Do you know when SVXMon issues auto-HRR
    f) Do you know what to look for in SVXMon to issue MANUAL HRR?

 4. ACNET
    a) Have you started fast time plots from ACNET page E11?
    b) Have you made entry in Downtime logger on page E8 and
plotted
       luminosity for the shift from E8?
    c) Have you made plots using lumberjack plotter on Page D44
(specially
       the three silicon plots)?
    d) Do you know what is on the "Store Monitor" page(E64)?

 5. Detectors
    a) COT
      * Do you know where COT PC is?
      * Have you seen COT low voltage setting in GLOBAL ALARM
SUMMARY
        page?
      * Do you know how to recover from COT low voltage trip (next
to
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        COT PC on first floor?)
      * Read "Important Notices" link from ACE page to learn how
to handle
        COT heartbeat alarms?

    b) TOF
      * Do you know where TOF PC is?
      * Have you ever recovered tripped channel of TOF?
      * Do you know what red, yellow and blue color mean for TOF?

    c) L00, SVX and ISL
      * Do you know where SILICON PC is?
      * Have you located and used PS GUI for L00, SVX and ISL?
      * Have you used IMON for unmarking/viewing history of a
particular
        silicon layer?

    d) CMU/CMP/CMX
      * Do you know where MUON3 PC is?
      * Have you ever recovered tripped channel of MUON detector?

    e) CEM/CHA/WHA
      * Do you know where PISABOX PC is? (also helpful for turning
on
        Xenon Flashers)

    f) PLUG DETECTOR(PEM,PHA and PSH)
      * Do you know where PLUG PC is?
      * Do you know the password of PLUG PC?

    g) BSU/TSU/CSP/CSW/MSK
      * Do you know where BSU HV PC (CCU PC) is?
      * Do you know where BSU HV instructions are?
      * Have you ever recovered tripped channel of BSU?

    h) Forward Detectors (CLC, BSC, RPS, MNP)
      * Do you know where CLC PC is?
      * Do you know the password of the CLC PC?

 6. VOLTMAN
    a) Do you know how to use VOLTMAN to look at power supply low
       voltages? (Hint - the VOLTMAN web pages will only open from
       a computer within the online network. ACNET terminals can
       not open VOLTMAN.)
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     b) Do you know how to capture a VOLTMAN plot for pasting in
        the elog?


  7. COMMON TRIPS
     a) Steve Nahn's "Holy Trinity": SVX, ISL, L00 all at once
           (usually means the silicon PC is slow or frozen)
     b) CES CPR CCR - muon scintillator PMT HV
     c) Muon scintillators (CSP, BSU, TSU, CSW, CSX, MSK),
heartbeats,
        etc.
     d) Plug - ramping up/down
     e) Muon chambers : high losses, especially when correlated
     f) Silicon :  VERY IMPORTANT TO KNOW HOW TO REACT TO THIS:
        high losses, standby to on, off to standby
     g) PSM alarm (clears immediately)
     h) Heartbeat alarms in general
     i) CLC alarms (check PC upstairs)

For Both Aces
=============

    a) Try to work together as much as possible.
    b) Keep an eye on channel 13 on control room TV monitors.
    c) Having an idea of where to look for instructions in case of
problems
       is highly recommended.
    d) In case you need to page somebody, ask SciCo to do it in
order to
       avoid confusion.
    e) Communication among shift crew members is very important
during
       shotsetups, DAQ problems,
        HV trips, unstable beam conditions etc.
    f) Making sure/helping CO doing his/her checks for various
detector
       subsystems is very important.
    g) Communicating with SciCo about good run bits (CCU trips for
example)
       and timely paging experts
       (for example, silicon general pager during shotsetup and
politely
       reminding them to page silicon
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      again after scraping is done).
   h) Do you know where the bathrooms are? ..coffee machine?
..lunchroom?
      ..40 cent pop refrigerator? ..tornado shelter? ..Silicon
Office?
   i) And last but not the least always remember : "Patience is a
virtue".
```

**Steve Hahn says: "Do you know the way to San Jose?"**

And an ex-ace-ess reminds all...

- All aces **must** wear the proper attire:
    - Ladies A
    - Gentlemen A
    - Gentlemen B

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Last updated by JJ and Sal - april 9, 2003